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Head

Annexure-II to the Minutes of Departmental Committee Meetings held on 8th April, 2026 (Item-II)

Entrance Examination Syllabus for the year 2027 and onwards for Admission to 4th Year of FYIMP in DS & AI (2-year Master's Programme in DS & AI)

Note: There shall be sixty questions, each carrying one mark. Weightage to be given to each section is indicated in parentheses. Paper setters are required to set the required number of multiple-choice questions with only one correct or most appropriate answer, separately for each section, ensuring uniform representation of the entire syllabus.

Unit I: Problem Solving with C (04)

Introduction to Problem Solving through programs, Overview of C programming language. Setting up the Development Environment. Flowcharts/Pseudocodes, the compilation process, Introduction to Syntax and Semantic errors. Writing and running a basic C program.

Variables and Data Types. Arithmetic expressions, Relational Operations, Logical expressions; Control Structures. Defining and calling functions. Recursion. 2-D arrays, Character Arrays and Strings. Basics of pointers. Dynamic memory allocation. Definition and use of structures.

Unit II: Python Programming (04)

overview of Python and its applications such as web development, data science, and automation, along with setting up the Python environment using tools like Anaconda and Jupyter Notebook. Python variables, basic operators, and the concept of blocks defined through indentation. Data types including numeric types (int, float, complex) and strings, along with string operations, program flow control using conditional statements such as if, elif, and else, and looping constructs including for loops with range and while loops. Data structures like lists, tuples, sets, and dictionaries, loop control statements such as break, continue, pass, and else. Programs using conditional statements, loops, and data structures in Python.

Unit III: Data Science (04)

Introduction to Data Science. Workflow of Data Science. Tools and Programming Languages. Data Sources and Formats. Data Science Process. Data collection methods- Data cleaning and pre-processing. Data exploration. Data modeling. Data distribution analysis. Basic tools (plots, graphs and summary statistics) of EDA. Introduction to Big Data. Steps in Big Data. Feature Engineering. General techniques for handling large data, missing data.

Unit IV: Data Structures using C (04)

Fundamental concepts of data structures including data types, objects, and structures, along with their representation and implementation. Linear data structures: arrays, their representation, operations, applications, and limitations. Searching techniques such as linear search and binary search, and sorting techniques: selection sort, insertion sort, bubble sort, quick sort, and merge sort. Two-dimensional arrays and matrices: operations, special matrices, and the array representation of sparse matrices. Linked lists: representation, types, and operations. Stack and queue data structures: their representation, basic operations, and implementation using arrays and linked lists. Applications of stacks such as parenthesis checking, infix to postfix conversion, postfix expression evaluation, and recursion implementation using stacks. Queue: simple queues, circular queues, deque, and priority queues.

Unit V: Algorithms Design & Analysis (04)

Introduction to Algorithms, Analysis of Algorithms, Growth of functions, Asymptotic Notations (Big-O, Big-Omega, Big-Theta), Complexity Analysis Techniques (Substitution method, Recursion Tree),Masters Theorem. Tower of Hanoi problem and its complexity. Search Algorithms (Linear Search, Binary Search), Sorting Algorithms (Selection Sort, Insertion Sort, Bubble Sort, Quick Sort, Merge Sort). Time complexity analysis of searching and Sorting algorithms.

Unit VI: Linear Algebra (04)

Scalars, Vectors, and Matrices: Definitions, notation, and basic, operations. Matrix operations: Addition, scalar multiplication, matrix multiplication, and transposition. Systems of linear equations: Row reduction, echelon forms, and Gaussian elimination. Determinants and Matrix Inverses: Definition and properties of determinants, Computation of determinants and matrix inverses. Application: Solving linear systems using inverses. Definitions: Formal definitions of vector spaces and subspaces. Linear Combinations and Span: Understanding the span of vectors and its significance. Basis and Dimension: Defining the basis of a vector space and exploring the concept of dimension. Rank-Nullity Theorem. Row space, column space, and null space of a matrix.

Unit VII: Artificial Intelligence (04)

Introduction and historical perspective, Artificial Intelligence-disciplines and applications, Types of AI, Theories of intelligence, Detecting and Measuring Intelligence, Turing Test, Future of AI Intelligent agent: Agent and Environments, nature of Environments, structure of Agent, Concept of Rationality, Search Strategies: Uninformed search strategies-Breadthfirst search, uniform cost search, Depthfirst search, Depth Limited and Iterative Deepening Search. Search with partial information (Heuristic Search), greedy best-first search, A* search, heuristic functions. Local Search Algorithm: Hill climbing, gradient descent, genetic algorithm. Knowledge Representation: Propositional logic, first-order logic, inference in first-order logic, propositional versus first-order logic.

Unit VIII: DBMS (04)

Introduction to Databases: Purpose of Database Systems, Components of DataBase Systems, Applications of Database Management Systems, Three Tier Database Management System Architecture, Data Independence, Database Schema, Instance, Data Modelling, Entity Relationship Model, Relational Model. Data integrity Rules, Functional Dependency, Normalization, First, Second, Third Normal Forms, BCNF, Multi-valued Dependencies, Pit-falls in relational Database design, De-normalization.

Unit IX: Evolutionary Computing (04)

Overview of Evolutionary Computing- Evolutionary Algorithms, Evolutionary Search Techniques, Principles of Genetic Algorithms, Encoding schemes and Representation. Selection, Crossover, and Mutation Operators. Evolutionary Strategies: Evolution in continuous variables. Transformations. Covariance Matrix Adaptation. Different Components of Evolutionary Algorithms- Framework, Populations, Selection operators, Genetic operators. Genetic Programming, Differential Evolution

Unit X: Probability Theory (04)

Probability: Sample space and events – Probability – The axioms of probability – addition law of probability – Conditional probability – Bayes' theorem. Counting Techniques: Permutations and combinations, applications in probability, discrete probability: finite and countably infinite sample spaces, inclusion-exclusion principle. Random Variables: Discrete and Continuous, Probability Mass Function (PMF), Probability Density Function (PDF), and Cumulative Distribution Function (CDF)– Distribution - Binomial, poisson.

Unit XI: Machine Learning (04)

Inductive learning algorithms. Categories of inductive learning algorithms. Rule extraction with inductive learning algorithms, Decision trees, ID3 algorithm. AQ algorithm, SAFARI algorithm Applications of Inductive Learning Machine Learning: Supervised, Unsupervised and Reinforcement Learning, Applications. Introduction to Classification: Overview, types of classification problems, binary vs. multi-class classification. Linear Regression, Logistic Regression.

Introduction to Clustering: Definition, types of clustering (hard vs. soft), applications, and importance.

K-Means and Variants: K-means algorithm, choosing the number of clusters (elbow method), K-means++.

Unit XII: Cloud Computing (04)

Cloud Computing definition, private, public and hybrid cloud. Cloud types; IaaS, PaaS, SaaS. Benefits and challenges of cloud computing, public vs private clouds, Business Agility: Benefits and challenges to Cloud architecture. VIRTUALIZATION: Role of virtualization in enabling the cloud: Types of Virtual Machines, Advantages of Virtualization, Components of Virtualization.

CLOUD APPLICATIONS: Technologies and the processes required when deploying web services; Deploying a web service from inside and outside a cloud architecture.

Unit XIII: Deep Learning Essentials (04)

Deep Learning vs. Traditional Machine Learning, Key Deep Learning Terminology, Shallow Architectures and Deep Architectures, Deep Learning Basics: Biological Neural Network, Artificial Neural Networks, Neuron as a basic building element of ANN, Activation Functions, Perceptron, learning with Perceptron, Limitations of Perceptron, Multilayer neural network, learning with Multilayer Perceptron, Training ANN using Backpropagation algorithm.

Bayesian Classifiers: Naive Bayes, assumptions, advantages, limitations, and Bayesian networks.

Support Vector Machines (SVM): SVM for linearly separable data, kernel methods for non-linearly separable data, hyperplane and margin concepts.

K-Nearest Neighbors (KNN): KNN algorithm, choice of K, distance metrics, and performance optimization.

Unit XIV: Digital Image Processing (04)

Introduction to Digital Image Processing, Origins of DIP, Examples, Fundamental steps in DIP, Components of DIP. Fundamental elements of visual perception: brightness, contrast, hue, saturation, Mach-band effect; Light and the electromagnetic spectrum. Image formation and digitization concepts; Image sensing and acquisition; Image sampling and quantization. Basic relationships between pixels: Neighbor's of pixel, adjacency, connectivity, regions and boundaries, distance measures.

Image enhancement in the spatial domain: Background; Point and arithmetic/logic operations; Some basic grey-level transformations; Histogram processing: Equalization, Matching.

Mechanics of spatial filtering: Correlation, Convolution; Smoothing spatial filters; Sharpening spatial filters.

Unit XV: Time Series Analysis & Forecasting (04)

Stochastic process. Time series as a discrete stochastic process. Main characteristics of stochastic processes-Auto-covariation and Autocorrelation functions. Stationary stochastic processes. Components of time series: trend, seasonality, cyclicity, and noise. Moving average (MA), Auto regressive (AR), ARMA and AR integrated MA (ARIMA) models. Box-Jenkins models, choice of AR and MA periods. Seasonal ARIMA models. Exponential Smoothing methods: Simple, Holt's, and Holt-Winters exponential smoothing